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## ***New Technology & Dry Land Agriculture***

### **A SOCIO-ECONOMIC CRITIQUE OF DRY LAND AGRICULTURAL DEVELOPMENT IN MEXICO AND THE SOUTHWESTERN UNITED STATES**

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Mexico's national economy receives little income from its arid and semi-arid lands. Although these lands cover over half the national territory, the inhabitants are concentrated in small urban oases, insulated from their environment. Likewise, commercial agriculture is limited to a few, highly capitalized irrigation districts. Most of the nation's lands remain unproductive, exploited by a cattle industry whose grazing patterns are so extensive that the animal carrying capacity must be calculated in hectares per head rather than head per hectare. As Mexico's irrigated regions have been increasingly transferred over to export and luxury crops and the country has been forced to increase imports of basic foods, it has become critical to consider alternatives which might permit the nation to take full advantage of its dry land agricultural potential. At a recent conference in La Paz; Mexican, United States and Canadian plant scientists discussed numerous potential plant resources native to Mexico and the Southwestern United State's arid lands.

A majority of these scientists expressed hope that promotion of such resources might improve the

socioeconomic conditions of the marginal peoples. It is here that we suspect a flaw in planning in that not all biological and agronomic research may lead to an increased welfare for arid lands peoples. In fact, some contemporary agricultural programs may even aggravate socio-economic problems.

Mexico does not lack potentially marketable plant resources. Richard Felger, for example, discovered that the aboriginal inhabitants of the Arizona-Sonora desert consumed over 15% of the regions 2,500 native plants and used another 25% for medicinal purposes. Yet today, all the important plants cultivated for commercial purposes in arid lands originated in tropical or temperate zones: wheat, rice, maize, soybeans, barley

and potatoes (Felger and Nabhan, 1976). Naturally, no one expects contemporary arid land inhabitants to return to an aboriginal diet, nonetheless, Felger and Nabhan estimate that 1.5%—which is to say 35—of the classified plants are potentially exploitable as food crops. This research points out the disequilibrium between the current uses of the desert and its historically proven potential.

Despite their large number, few potential plant resources ever become marketed. Even if a new plant resource meets the needs of a region's inhabitants, even if a new resource protects the natural environment from possible environmental damage, and even if the new resource appears to have high production estimates; in most instances

the resource receives little support from research institutes and the government agencies responsible for the agricultural development of the nation's arid lands.

It appears that the creative energies of workers in the natural sciences are dissipated before their research findings can be incorporated into the realities of international and national economics. It is easy to blame "political", "social" or "economic" factors for this dissipation and say no more. But from the viewpoint of an economic anthropologist, agricultural economist, or sociologist, the expression "social and economic factors" lacks specificity and clarifies nothing. It would be as if an agricultural economist were to attribute a particular problem to biological factors, without further specification. For this reason it is necessary to be more precise as to what social and economic factors are considered in an overall evaluation of a new natural resource being brought into arid lands. To avoid speaking in general terms about such an important theme, examples may be derived from the two crops receiving widespread attention in arid land science: jojoba and guayule.

Among the various plant resources, jojoba (*Simmondsia chinensis*) and guayule (*Parthenium argentatum*) have been receiving the highest scientific priority as plants that offer some possibilities for the development of commercial agriculture based on indigenous arid lands flora. Although many plants could be exploited in such zones, these two have commanded the most attention, supposedly because they are native species requiring a minimal quantity of water for their production. Moreover, they are possible plant substitutes for hydrocarbon resources which are becoming increasingly scarce on the world market.

Jojoba is found in its natural state in the Arizona-Sonora desert, on the peninsula of Baja California and is also cultivated in Israel and other areas of the arid world. Oil derived from the jojoba seed offers almost a direct substitute for the high quality oil that has heretofore been obtained from the sperm whale. Like sperm whale oil, jojoba oil possesses ideal characteristics for as a high quality industrial oil in that it is resistant to high pressures and temperatures. The protection of the sperm whale, spurred by the active interaction of environmental groups, has

increased the necessity to look for substitutes such as jojoba (Hamilton and Keng, 1978). Other scientists have demonstrated that jojoba oil may also be utilized in the cosmetic industry where it offers a high quality substitute for safflower, olive oil and white petroleum (Taguchi, 1978). Moreover, the oil extracted from the jojoba seed also has the characteristics of an anti-foam agent which can be used in the fermentation of antibiotics in the pharmaceutical industry.

These and other possible industrial uses have stimulated over a hundred scientists to investigate the possibility of its commercial exploitation. Numerous institutes have participated in jojoba studies, including the Consejo Nacional de Ciencia y Tecnologia (the National Science Foundation of Mexico), the Comision Nacional de Zonas Aridas (the National Arid Lands Commission of Mexico), the Department of Agriculture of the United States, the National Science Foundation and a score of centers of investigation and state universities on both sides of the Mexican-U.S. Border. In the Second Congress on Jojoba, scientists from Mexico, United States, Israel, Sudan, Holland, England and Australia presented 27 papers on the diverse aspects of this product. And even though few social scientists attended this conference, the conclusions arrived at by the participants supported continuing investigation on jojoba precisely for social-economic reasons. They said that:

*Whereas jojoba is a plant that can be cultivated on presently unproductive arid/semi-arid lands where populations of low income peoples live...(we consider) that the development of a jojoba-based agro-industry in those regions will provide a rare opportunity to establish a viable economic base, thereby reducing the present high social overhead costs now being borne by the government (CONACYT, 1978).*

In contrast to jojoba, guayule has a previous history of commercial exploitation. Between 1910 and 1946, the Continental-Mexican Rubber Company and other smaller enterprises exported 68,000 tons of Mexican Company and other smaller enterprises exported 68,000 tons of Mexican rubber to the United States (Velasques, Martinez and Aguirre, 1978; McGuinness, 1978). During the Second World War the United States and Mexico promoted the rapid

expansion of guayule, most of which was cultivated in irrigated areas of California. Official support terminated abruptly at the end of the war following the United States' recovery of its Asiatic markets for natural rubber. Natural rubber prices decreased, and synthetic rubber became competitive with guayule. As a result, the commercial cultivation of guayule came to a complete halt.

From a marketing perspective, guayule is very similar to the situation of jojoba. It is almost a direct substitute for *hevea* rubber, another basic industrial resource. As a source of hydrocarbons, *hevea* rubber and the rubber produced by the guayule plant have similar chemical and physical characteristics (National Science Foundation, 1977; CONACYT, 1978). Guayule and jojoba are also similar in that, as occurred in the case of jojoba with respect to the sperm whale, the high demand for rubber appears to be surpassing world supply. It has been calculated that the demand for natural rubber will increase at the rate of 5.9% annually, while supply does not appear to be able to increase at more than 3.8% (Broad, 1978). Of course, other political-economic reasons favor guayule research: the nations who are large consumers of natural rubber view their sources in Southwest Asia as very unstable. For Mexico, a country that has traditionally imported such natural rubber, it is also a very attractive possibility to have a national source of this product. It has been estimated that in the arid zones of Mexico there are more than 4 million hectares of guayule, mostly located in the Chihuahua desert. If this estimate is correct, Mexico has a reserve of more than 280,000 tons of guayule.

These socio-economic and political considerations have stimulated a renewed interest among the large transnational rubber companies in developing an alternative source of rubber. The National Academy of Sciences in the United States, sponsored a study specifically concerning this product (NAS, 1977) which concluded that guayule could not be competitive in the world market with *hevea* rubber if it were to be produced with the same technology and under the same systems of cultivation used during the war. Nevertheless, the authors of the study hoped that with genetic advances and improvements in agricultural technology (plague control, weed control, and mechanization), it

would become competitive. As a concrete indication of an interest in guayule, the United States Congress recently appropriated \$30 million to support its research and commercial development (NAS, 1977). It is important to note that the United States National Academy supported the development of guayule for the same socio-economic reasons that were employed by the promoters of jojoba. After noting the depressing socioeconomic conditions of Mexican peasants and North American Indians who reside in potential guayule producing areas, the national Academy report concluded that its cultivation would help these marginal groups develop an economic base that would contribute to decreased unemployment and a reduction in their economic dependency on their respective governments.

In less than a year, scientific recommendations had reached the level of international politics. Given the increased attention being placed on the problems of undocumented aliens entering the United States from Mexico, Representative George Brown recently proposed that the United States establish programs of agricultural development, in cooperation with Mexico, to reduce the flow of migrants by providing job opportunities on the Mexican side of the border. Moreover, he specifically would provide Mexican peasants with employment and, thereby, reduce the flow of migrants as well as alleviate the problems of unemployment in Southwestern Indian reservations (Uno Mas Uno, 1979).

Thus, arguments favoring research and development of this or that resource, looking toward the betterment of socio-economic conditions of marginal persons who inhabit arid lands, appear to be important justification for research and development efforts, not only to governmental agencies involved but also to the scientist specialists in the natural sciences who perhaps desire to morally justify their respective researches. For such a reason, it is worth discussing what type of socio-economic base might be constructed through the cultivation of jojoba or guayule. This discussion will suggest that other criteria are employed by government agencies and the scientific communities in their decisions as to whether to support or not support the exploitation of a plant resource, apart from an improvement in socio-economic welfare.

### Ecological Characteristics of Plant Resources Important to Their Exploitation

In order to evaluate the potentials of an agricultural product for the socio-economic development of a region, a social scientist has to clarify, from the point of view of cultural ecology, which biological characteristics of the plant will affect its exploitation. Several technical and ecological problems limit the economic exploitation of jojoba and guayule. In their wild state, both are very dispersed. Jojoba specialists have also observed the plant is sensitive to microclimatic and micro-ecological differences (Gobierno de Baja California Norte, 1978; Heriberto Parra H. and Jorge Sepulveda B., 1968; and Murrieta, 1978). Equally, the yield of the undomesticated plants shows considerable variation, depending on the quantity of precipitation that is received in an area. Such variation is an extremely important ecological and economic characteristic because one of the dominating factors or characteristics of arid zones is in instability and inequality of the rainfall distribution. Thus, it is evident that harvests based on the cultivation of wild stands would vary greatly between locations as they would between from year to year.

For these reasons, most agro-economic and biological investigations focus upon the domestication of the shrubs for cultivation in fixed locations and not upon the development of the plant in its wild habitat. Due to the large variations in yields which result from the erratic distribution of rainfall, such investigators have supported the utilization of irrigation for jojoba and, at times, for guayule; thereby negating one of the original reasons for supporting these plants in the development of arid lands. This, as we shall see, is one of the structural conflicts that are encountered in this problem. In effect, jojoba and guayule, cultivated under conditions of irrigation, not only compete with their substitutes in the world market, but they also compete with other cultigens for scarce water. These competing cultigens not only include highly valuable export crops but also food crops. A shift to these native cultigens might not only increase the farmers' dependence on agricultural export markets (in the case of Mexico), but it might also increase arid land agriculturalists dependency on food products which must be produced in

other areas. Of course, it would be a mistake to think that economic competition for land use in arid lands is limited only to irrigated regions. If, as it is being discussed, there was extensive cultivation in guayule and jojoba on Northern Mexico's non-irrigated lands, consideration must be given to the most common, contemporary use of such zones, extensive cattle raising. Since both species may also be utilized as wild pasture for cattle, the result would be that the two plant resources would be in direct ecological and economic competition. This competition could be resolved by fencing, but this would be an additional cost of production of such plant resources. Furthermore, coexistence of jojoba or guayule and cattle could likewise increase the social and political conflicts already existing with respect to land tenure in these regions of Mexico.

### Systems of Production

From the socio-economic perspective, the most important factor to be considered in the cultivation of new plant resources is its specific form of cultivation and processing. A variety of possible systems of production exists for each cultigen and each system of production corresponds to one or more social organizations of production. To analyze the socio-economic impact of the cultivation of new resources, it is necessary to determine precisely what types of social relations of production would result from the product's cultivation and processing. Without such an analysis, it is impossible to determine who would benefit from the plant's commercial development. This implies an overall analysis not only for each new crop but also for each of the different systems of production being considered for that crop. These analyses are not easy. Nonetheless, it is worth attempting if for no other reasons than to test the assumption that the development of a crop will improve the socio-economic conditions of a region's inhabitants. To illustrate precisely how the analyses might be conducted, it is useful to return to the cases of jojoba and guayule.

The majority of the current studies on the cost of production of jojoba considers only two systems that employs an extensive use of machinery in the cultivation and harvesting. The later option is somewhat hypothetical since more research is

still necessary for the development of machinery that can efficiently pick jojoba beans. It is also probable that agricultural machinery will only be applicable to relatively flat lands; a possibility which immediately excludes much of the potentially useful arid lands for the production of this crop.

Murrieta (1968: 275-282) has analyzed the probable production costs for parcels between 1.5 and 10 hectares in the state of Sonora. He demonstrates that the decreasing economies of scale do not favor parcels of 5 hectares or less. Furthermore, he suggests that jojoba production shows no increased economies to scale for farms greater than 10 hectares. In Mexico, these findings suggest that jojoba could be potentially cultivated by small, ejido farmers. Stubblefield and Wright (1978) have also conducted an analysis of the cost of production of jojoba, focusing on two systems—one involving intensive manpower and the other mechanization. The Stubblefield-Wright analysis was specifically oriented towards production of jojoba on the San Carlos Apache Indian Reservation, located in Arizona. Comparing the production costs of the two systems of cultivation presented by these investigators (Sonora and Arizona: manpower intensive; Arizona: mechanized) it may be observed that in Arizona the greater part of the jojoba production costs is for labor. Consequently, the unitary cost of production (pesos/Kg of seed) indicated that the mechanized systems would be much more profitable than that using intensive manpower (19.52 pesos/Kg as compared to 31.04 pesos/Kg).<sup>1</sup> Nonetheless, neither of the United States systems is able to compete with manpower intensive, jojoba cultivation on the Mexican side of the border (12.15 pesos/Kg). Does this comparison imply that the most probable system to be used in the cultivation of jojoba would be that of manpower intensive cultivation in Mexico? No. Yet another cultivation system must be considered, one which has received little attention, an agro-industry option. It seems strange that this option has been ignored by the three agricultural economists, since it tends to be the dominant form in Sonoran agricultural investments. If an agro-industrial system were developed for the cultivation of jojoba which combines the production costs

projects by Murrieta in terms of manpower (until the harvest) with the mechanization costs proposed by the Arizona investigators for harvest and cleaning, a more competitive solution than any of the three previous systems could be achieved (Table 1). In brief, a jojoba agro-industry, located on the Mexican side of the border, which combines the low cost of Mexican manpower, water and land with the high technology of North American machinery imported into Mexico, appears the most competitive solution from the point of view of investment. The unitary cost of such a hybrid system would be less than 6.37 pesos/Kg, far below that of any other system under consideration. Although a more precise analysis of the production costs in this system might be provided, the direction of these results would not change.

In contrast to the situation of jojoba, almost all scientific efforts exploring guayule production on both sides of the border are focused upon a single production system, that of highly mechanized agriculture. In their preliminary economic analysis of the production cost of guayule, Nivert, Climph and Snyder propose a large processing plant, covering the needs of an area larger than 20,000 hectares (1978: 357-374). They suggest that the plant would sell seeds to farmers and cover the entire costs of harvesting and processing. Harvesting and processing would be mechanized, avoiding diseconomies caused by high labor costs. The agriculturalist would obtain inputs from the same company which would own the processing plant. He would also receive credit from the same. Furthermore, the company would set the price for the product. In this way, the agriculturalist, even though he

owned his land, would be working virtually as a sharecropper on his property.

Certain omissions prevent a detailed analysis of the socio-economic impact of their cultivation and processing scheme. There is no mention, for example, of where this large business would be located. In Mexico? In the United States? Furthermore, there is no information to the effect that the majority of the employees would be only part time. Finally, no specific mention is made of the salaries that would be paid to the temporary workers or the farmers themselves or whether the employees would receive the social benefits normally provided a worker along either side of the Mexican-United States border. Such considerations are extremely important for those who attempt to evaluate the socio-economic consequences of this agricultural development.

Social scientists encounter a rather strange situation. On the one hand, they are assured that further research and development of a resource will contribute to an improvement in the socio-economic conditions of the inhabitants of an area but, on the other hand, the information necessary to evaluate the validity of this socio-economic conclusion is inexplicably missing. Could it be that those favoring the resource's development wish to avoid a serious consideration of this question? And who, precisely, is backing the continued research and development of these arid land crops? The three United States researchers who developed the production cost analysis for guayule are employed by the world's largest transnational rubber company, Firestone Tire and Rubber Company. Further evidence of the transnational rubber com-

PRODUCTION COSTS COMPARISON OF VARIOUS CULTIVATION SYSTEMS OF JOJOBA DURING 7TH YEAR OF PRODUCTION (\*)

Pesos/Hectare	Intensive Manpower		Mechanization	
	Sonora (1)	Arizona-Apache (2)	Arizona-Apache (2)	Sonora (3)
Production costs (excluding harvest)	15,363	74,865	53,198	15,363
Costs of harvesting, cleaning, hulling	19,613	14,414	2,950	2,950
Total cost	34,976	89,279	56,148	18,313
Unit Cost (\$/Kg)	12.15	31.04	19.52	6.37

(\*) Units of 5 hectares, with an annual yield of 2.876 Kg/hect.

(1) Murrieta (1978: 282-283)

(2) From Stubblefield and Wright (1978, Tables 1 and 4)

(3) Based on the employment of mechanized technology developed in Arizona, practiced in Sonora.



pany's interest in this scientific research can be found in the National Academy of Science publication, where more than half of the 22 text were signed by personnel working for one of the three transnationals (Firestone, Goodyear, or Goodrich).

The cases of guayule and jojoba offer two variations on a common theme so often encountered in programs which supposedly support the "technology transfer" from a developed to an underdeveloped country. The first variation occurs when a group of university scientists of the first world cooperate with scientists of the large transnational companies, supposedly to develop a process or plan that will be exploited *within* the developed country. Land grant agricultural schools consider such cooperative projects their "bread and butter" grants. Unfortunately, the resultant technology is often specifically designed for exportation to a country whose low production costs increase the profits of the transnationals. Moreover, not only is agricultural technology being transferred to a recipient country, but also an entire socio-economic system which is inexorably involved with such technology is transported as part of "development package." The profits accrue to transnationals, with minimal returns to primary producers and host country. The developed country's universities win an ironic return on their investment: more money to continue investigations which will provide agrobusiness with even larger, future profits.

Guayule offers a perfect example of this variation. The technology being developed in U.S. universities is tightly intertwined with the needs of the transnationals controlling the world rubber industry. The technology, in turn will support the development of a system of production based on a plantation economy and involve extremely proletarianized social relations of production.

In the case of jojoba, the theme is slightly modified. Jojoba cultivation is so experimental (i.e. risky) that no transnational has, as yet, invested in its development. Nevertheless, the universities, the respective national federal governments, and the national science foundations (CONACYT and NSF) are supporting the first experimental steps in this direction. If this experimental research proves profitable, it is also obvious that jojoba and guayule will *not* be exploited com-

mercially for the benefit of the marginal populations of the Indian reservations of Arizona and California, for the simple reason that better opportunities for capital accumulation and profits can be found a few kilometers to the south, in Mexico. Who dares inform the Indians on the San Carlos Apache Reservation in Arizona of this situation? Would the Indians be so content with the experiments being conducted on their reservation, if they realized that they were subsidizing the development of a system of agriculture that, if it works, may well be exported? Finally, how many of our university scientists would be willing to continue their enthusiastic support of the development of a product whose final beneficiaries will not be marginal populations?

Turning to the other side of the border, even more serious issues can be raised. Agro-industry requires large investments of capital, fundamentally in machinery. Naturally, Mexicans will have to import such machinery from the country where it was developed, thereby increasing a recurrent balance of payments deficit. Mexican economists know that employment in this system would be temporary. U.S.-Mexican agro-industry has never turned over any of the surplus value it has accumulated to agriculture workers. That this custom will continue may be noted in the discriminatory use of a *minimal* agricultural wage in the preceding production cost calculations. All this implies that instead of diminishing unemployment and the problems, it is more likely that the "solutions" will increase the migratory and labor problems extant in the area, creating an even larger mass of seasonal unemployed, landless workers living in the northern parts of the country, and also increasing the flight of Mexican capital to the United States.

Until the supporters provide better evidence, it is unfair and unjust to support continued scientific investigations for humanitarian reasons. In reality, it appears that such research is potentially beneficial to American agrobusiness abroad with, *perhaps*, some beneficial side effects for the wage laborers who will be temporarily employed. Such considerations raise delicate and often forgotten ethical questions. Are biologists, agronomists, and ecologists morally obligated for the socio-economic consequences of their scientific work? If biological warfare research were being considered, then most

would give an immediate, affirmative answer to this question. But why hesitate to extend the same morality to biological investigations which lead to equally disastrous, if not more prolonged suffering to human beings? Which is worse? Quickly killing a Mexican peasant with a microbe developed in a secret laboratory or subjecting him to an agricultural system in which his welfare is dependent upon the whims of those who control an agro-economic system, one which was partially designed by a biological scientist in a U.S. university?

### Alternative Systems of Production

We have argued that biological and agronomic research can support the expansion of agricultural products, linked with associated systems of production, which are detrimental to the social and economic welfare of marginal peoples living in arid lands. Future action, however, is more important than past responsibility. Although most previous research has encouraged the expansion of agro-industry at the expense of small farmers, Mexican peasants, and Reservation Indians, it might be hoped that future research could be reoriented toward the development of agricultural production systems which improve the lives of marginal peoples. To avoid the politically naive position of believing that any new technology or agricultural development invariably improves human welfare, specific socioeconomic objectives may be suggested, against which projects, proposals, and research plans may be evaluated. The evaluation process must not be limited to scientific peers, but must also include the "clients" who supposedly should benefit from the scientific endeavors. In the specific situation of dry land agriculture, a politically aware set of research objectives would favor research on crops and production systems which

- a. require minimal water needs (marginal peoples have long ago been excluded from highly productive, irrigated lands in most parts of Mexico and the United States),
- b. are labor intensive,
- c. show minimal seasonal variations in labor demand, thereby minimizing the recurrent problems of seasonal unemployment,

- d. offer sustained yields, including multicrop and diversified cropping sequences,
- e. have commercial value,
- f. require minimal purchased inputs (fertilizers, machinery, improved seeds, etc.) which might tie farmers into a credit-debt-credit cycle,
- g. include some non-commercial food crops suitable for home consumption by the farmer, and
- h. offer the producer the option of home processing of what he produces, if he so desires.

These eight objectives may be considered ideals, against which contemporary agricultural development projects in dry-land, arid agriculture may be evaluated. They must appear formidable to those concerned with agricultural development, especially since many demand non-technological solutions and all require increased attention to the producers' socio-economic conditions. Yet, on further thought, why should this set of criteria be considered more objectionable than profit maximization? Goals similar to these are receiving increased international attention under the guise of ecodevelopment and similar new development philosophies (Downing, 1978).

Again, let us return to the jojoba case for a clearer indication of a cultivation system which more closely corresponds to the objectives than the previous described systems. University of Arizona researchers are considering an alternative jojoba cultivation system based on the plant's manipulation in its natural setting. The producer fertilizes, prunes, and completes small scale

runoff control of plants located in their natural habitats. The system involves the planting and manipulation of arid lands species in non-irrigated areas and need not be based upon a plantation organization, rather it would concentrate on dispersed arid lands products which show commercial viability. The system has an additional advantage, it may be utilized in relatively rough terrain and without the need for expensive irrigation networks or complex machinery. In this system, labor represents over 90% of the costs of production (Table 2). Preliminary analysis indicates that an adaptation of this system to jojoba cultivation is competitive with that of agro-industry, yielding an unitary cost of 2.36 pesos per Kg in contrast with the 6.00 pesos for agro-industry. Of even greater importance, the majority of the surplus generated by this system of cultivation would go directly to the peasant or small farmer.

The design being considered still falls short of several of the aforementioned objectives (specifically c, d, g and h), all of which might be resolved by considering the collatera 1 development of other arid lands food crops rather than focusing exclusively on jojoba. Moreover, the manipulated natural system faces the persistent problem of competition with cattle. Nonetheless, a preliminary analysis of the production costs of the manipulated, natural habitat system suggests it merits serious consideration, as it appears competitive with the agroindustrial option. In contrast to the unspecific support of a particular plant resource

such as is suggested in the jojoba and guayule research publications, we favor a qualified support of plant resources with specific designation of the socio-economic objectives to be held by the plant scientist. Let it be clear that we are not objecting to guayule and jojoba as potential arid lands resources, but to a scientific *laissez faire* attitude, which results in the *de facto* support of one cultivation system over another which might have more direct, beneficial results for the marginal inhabitants of the area.

## Conclusion

Research in the natural sciences (biology, chemistry, agronomy, etc.) will always be subject to the political and economic winds. Decisions whether to support this or that plant resources in arid lands cannot avoid this process. Agronomic and biological research supports decisions which ultimately encourage certain production and processing methods over others. These methods, in turn, support the development of production and processing systems which correspond to specific socio-economic organizations of production. Some of these organizations may subjugate producers to conditions which may *not* improve their socio-economic conditions. Thus, agronomic and biological research can either improve or worsen their human condition. It is imperative to understand, as much as possible, the anticipated social and economic consequences of alternative research decisions in the natural sciences, especially when the natural sciences attempt to justify their work on the basis of its beneficial impact on the human condition. In contemporary agriculture, the objectives and motives of the supporters of technological developments demand special attention.

In countries where the objective of agriculture development is the accumulation of capital in the hands of a small, dominant and wealthy group and where the scientific researchers receive political and economic support from the same; the majority of scientific investigations will be oriented towards the development of systems of cultivation, production, processing and marketing that increase the accumulation of capital for the dominant classes. Moreover, since the production costs in such situations are always changing and in a state of

### CULTIVATION SYSTEM BASED ON INTENSIVE MANPOWER: MANAGEMENT OF JOJOBA IN ITS NATIVE SITES IN MEXICO (1)

Production costs (1)	Pesos
Fertilizer, 20 units of Nitrogen	\$ 5,650
Pruning equipment	1,130
Plastic covers (to control temporary runoff/drainage)	11,305
Truck operation costs	6,785
	<hr/> 24,870
Harvest labor costs (2)	18,200
Transporting harvest	6,000
Administration costs during harvest	4,500
	<hr/> \$53,570
Total Cost (3)	
Yield estimated: 22,700 Kg for 20 hec	
Unit costs	2.36 (1976) <sup>4</sup>

(1) Estimates for fertilizers, pruning equipment, plastic, transportation, and labor needs are based on OALS Report, March, 1978.

(2) Harvest labor costs are based on Murrieta figures (1978:33)

(3) Total costs calculated in 1976 pesos in order to arrive at figures matching costs calculated by Murrieta and presented on Table 1.

(4) Adjusting for 1979 pesos, unit costs are approximately as follows: manpower intensive: Sonora \$21.99, manpower intensive, Arizona \$31.04; mechanization: Arizona \$19.52, Sonora \$11.53; and manpower intensive operating in jojoba native sites: Sonora \$4.27 per kilogram.

flux, these powerful elites find it necessary to be constantly experimenting with alternative possibilities for the accumulation of capital. At the same time these usually exist an orientation that the substituting of some resources for others, such as the substitution of guayule for hevea rubber or expensive Californian for cheap Mexican farm labor is justifiable on the basis of greater profit and increased market control. In a sense, scientific investigations form part of the vanguard of the future of many political processes, which may work to the disadvantage of the poor and powerless.

Even though it might be true, as one of the participants of the symposium at La Paz suggested, that ecological zones do not recognize international borders; in the realm of economic systems borders cannot be ignored. The wage-labor costs in Sonora are significantly different from Arizona, despite the fact the desert is the same. The results of scientific investigation made on one side of the border may, under certain conditions, increase the influence of powerful groups and aggravate the social problems of the marginal inhabitants on the other side. But, under other conditions, they may reduce the socio-economic difference not only between countries but also between social classes.

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1979, p. 12 (also see Congressional Digest, 27 March 1979, for Representative Brown's declaration).

\* Downing is Project Director at the Centro de Ecodesarrollo and on leave from the University of Arizona where he is Director of the Bureau of Ethnic Research. Restrepo is Director of the Centro de Ecodesarrollo. Restrepo is Director of the Centro de Ecodesarrollo. A modified, Spanish version of this paper will appear in a forthcoming Consejo Nacional de Ciencia y Tecnología publication entitled Recursos Vegetales de Importancia para el Desarrollo de las Zonas Áridas.

## Newsletters on International Socioeconomic Development

The following list of Newsletters is intended to be of use to people interested in international socioeconomic development. We are quite certain that it is only a partial representation of the newsletters that exist. The list was compiled from newsletters that we receive, newsletters that are mentioned in other sources, and from the *National Directory of Newsletters and Reporting Sources: A Reference Guide to National and International Information Services, Financial Services, Association Bulletins, and Training and Educational Services* (2nd Edition, 1978, Detroit: Gale Research Co.). We have attempted to indicate the frequency of publication, any costs, and languages other than English in which the newsletters are published. In many cases, we could not obtain this information from our sources. Names of newsletters and addresses are accurate to the best of our knowledge. We would appreciate readers sending us additions to and corrections of this list.

## Amaru IV

In 1978, AMARU IV was formed as a consulting firm for social policy research and social sector service delivery. Anthropologists, ecologists, and historians work together with applied technical professionals to develop social policy alternations promoting popular participation. AMARU IV is organized as a cooperative and is dedicated to the alleviation of the human condition in harmony with the environment and the dignity of individuals and social groups. Membership in the cooperative is open to any person who participates on an AMARU IV project. For additional information write; AMARU IV Cooperative, West End Station, box 57155, Washington, D.C. 20009.

## Rockefeller Foundation

For the seventh year, the Rockefeller Foundation is continuing a small program of two-year postdoctoral appointments in institutions overseas for young North American social scientists interested in international agricultural development. The program is intended to provide new Ph.D.s an opportunity to apply their training to practical problems of agricultural development. Although the postdoctorals will usually

work with more senior social and agricultural scientists, they will frequently be designing new research and creating new roles not before filled in the institutions. For additional information please contact: Charles K. Mann, Associate Director, Agricultural and Social Sciences, The Rockefeller Foundation, 1133 Avenue of the Americas, New York, N.Y. 10036.

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